

# Urethral Slings Placed by the Transobturator Approach: Evolution in the Technique and Review of the Literature

*Alan W. Shindell, MD and Carl G. Klutke, MD*

## Address

Department of Surgery, Division of Urology, Washington University Medical Center, Campus Box 8242, One Barnes-Jewish Hospital Plaza, St. Louis, MO 63110, USA.

E-mail: shindell@msnotes.wustl.edu; klutke@msnotes.wustl.edu

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Midurethral slings have proven to be efficacious in the surgical treatment of stress urinary incontinence (SUI) in women. A relatively new approach to the midurethral sling technique is the transobturator route for placement of the sling. This approach offers the theoretical safety advantage of avoiding the retroperitoneal space. The procedure has been pioneered in Europe and is now being practiced in the United States. In this article, we describe the theory behind urethral slings for SUI, the anatomy of the obturator canal, and early data on the safety and efficacy of transobturator urethral slings in the treatment of SUI.

## Introduction

Stress urinary incontinence (SUI) is defined as the involuntary loss of urine associated with activities that increase intra-abdominal pressure, such as coughing, sneezing, laughing, squatting, or performing the Valsalva maneuver [1]. The prevalence of SUI in the United States is very high, with approximately 10% of middle-aged women experiencing daily leakage and one in three experiencing leakage at least once a week [2]. Risk factors that have been associated with SUI include Caucasian race, uterine leiomyomata, high parity, vaginal birth, obesity, and age [2]. SUI can be a cause of significant social embarrassment and may lead to negative changes in lifestyle and self-esteem.

## Mechanisms, Evaluation, and Nonsurgical Management of Stress Urinary Incontinence

The prevailing theory regarding the mechanism of normal continence in women is the "Hammock Hypothesis" pro-

posed by DeLancey [3•]. It is thought that the anterior vaginal wall and endopelvic fascia serve as a stable base upon which the urethra rests. As the bladder fills, the urethra is compressed against this firm base. SUI is thought to be the result of laxity of this urethral support. Without a firm base against which to compress at the time of cough and strain, the urethra cannot coapt to compensate for the increased intra-abdominal pressure and urinary leakage results [3•].

Evaluation of SUI should always include history and physical examination, urinalysis, voiding diary, and a cough stress test. The routine use of urodynamics is controversial, but may aid in the management of patients who present with a complex history or who are considering surgery [2]. It is imperative to distinguish SUI from urge and overflow urinary incontinence. Abnormalities of bladder filling may coexist with SUI in up to 30% of patients and have been associated with decreased response to SUI therapy [4].

Nonsurgical management approaches for SUI include weight loss, pelvic floor muscle training (Kegel exercises) with or without biofeedback or vaginal weights, timed voiding, estrogen therapy, vaginal pessaries, and urethral inserts [2,4]. Pelvic muscle exercise programs are inexpensive and safe and have proven efficacious in the treatment of SUI [5].

## Surgical Management of Stress Urinary Incontinence

For SUI refractory to conservative management, various surgical approaches to the treatment of SUI have been developed. Techniques include colposuspension, transvaginal needle suspensions, anterior vaginal repairs, pubovaginal slings, and retrograde injection of collagen, carbon coated beads, or adipose tissue into the periurethral injections for urethral bulking [4]. The most recent American Urological Association (AUA) guidelines favor colposuspension and pubovaginal slings over other surgical modalities, with 4-year cure rates for both procedures estimated to be approximately 80%, with an additional 10% of patients reporting improvement in symptoms [4]. Choice of procedure depends in large part on patient and surgeon

preference; other important considerations include pelvic organ prolapse, patient performance status, and the presence of intrinsic urethral sphincter deficiency [4]. Both procedures have been shown to carry a risk of new-onset detrusor overactivity. Bladder injury and erosion of graft material is more common with slings, while longer recovery and longer time to normal voiding are more common after colposuspension [4].

The concept of urethral slings for incontinence dates back to the beginning of the 20th century [6]. The first modern urethral sling procedure was performed in 1942 by Aldridge [7] using rectus fascia as the suburethral sling material. Since that time, a variety of different sling materials have been introduced with varying degrees of success. Fascial slings may be created from autologous tissues (most commonly fascia) or from human or animal donors. Synthetic slings are composed most commonly of polypropylene, silicone, polytetrafluoroethylene, and polyester [4]. Autologous tissue slings generally are well tolerated, but the use of such materials requires an additional procedure and potentially longer recovery times. In a recent review of the literature by Bukkapatnam and Rodriguez [8], it was found that slings derived from human or animal donors had less durability than synthetic slings. Slings derived from humans and animals also carry the theoretical risk of transmission of infectious agents. Given these concerns, synthetic materials have emerged as the preferred option for urethral slings. Polypropylene is the most popular synthetic material in use today [8].

### **The tension-free vaginal tape procedure**

The tension-free vaginal tape (TVT) is a polypropylene midurethral sling, the purpose of which is to restore the physiologic firm base necessary for adequate urethral resistance during physically stressful activities. TVT was introduced in 1995 [9] and quickly obtained widespread acceptance due to its simplicity, tolerability, and efficacy. The procedure is performed through a small anterior vaginal incision. A trocar is used to guide the TVT tape through the vaginal incision in a retrograde fashion through the urogenital diaphragm and the retropubic space. The trocar penetrates the suprapubic skin, first on one side and then the other, and the tape is drawn up through the suprapubic incisions so that it forms a U-shaped sling inferior to the urethra [10]. A modification of the technique, sometimes referred to as the percutaneous vaginal tape (PVT), differs in that the mesh is inserted suprapubically and drawn out through a vaginal incision in an antegrade fashion [11,12]. Pre-pubic placement of a TVT sling also has been reported and has been associated with an 81% resolution of SUI symptoms with no perioperative complications, although median follow-up was just 5 months [13].

The principle advantages of TVT include the relative simplicity of the technique and short operating times. Performed under local anesthesia with sedation and using a cough test, the procedure allows the surgeon to tailor the

degree of resistance applied to the urinary outlet to the needs of the individual patient, thereby reducing the risk of over- or under-correction. TVT has proven to be highly efficacious, with most studies quoting 84% to 95% cure rates at up to 56 months after surgery [14]. A randomized trial comparing TVT with colposuspension showed similar efficacy for both procedures, but lower morbidity was associated with the TVT [15].

Although the TVT procedure is efficacious and well tolerated, a variety of complications have been reported. The most common of these is bladder perforation by the trocar, with an incidence between 1% and 21% [16••]. If the perforation is not recognized at the time of operation, the patient may present with hematuria or persistent incontinence in the postoperative period [17]. Retropubic sling procedures also have been associated with an infection rate of up to 7.5%, which may necessitate removal of the sling [18]. Other complications include short-term bladder outlet obstruction, which may require an indwelling catheter [10], urinary retention requiring resection of the tape, pelvic hematoma, blood loss, graft erosion into the vagina or bladder, necrotizing fasciitis, and injury to bowel or blood vessels. Seven deaths have been reported after TVT, most commonly due to bowel or vascular injury [2,19–22].

### **The transobturator urethral sling**

A relatively new technique in midurethral slings is the placement of a sling through the transobturator approach, in which the sling passes beneath the urethra and out through the obturator foramina. The first use of the transobturator approach for the treatment of urinary incontinence was performed in female dogs [23]. The advantage of the transobturator approach is that the retropubic space is not violated and hence the risk of bladder, peritoneal, or major vascular injury is theoretically lower than with TVT. Additional potential benefits involve less passage of the trocar through scar tissue in patients with a history of pelvic surgery and shorter blind passage of trocars in obese patients.

The obturator foramen typically is oval in women and round in men. It is surrounded by the bodies and rami of the pubis and ischium inferomedial to the acetabulum. A fibrous obturator membrane covers the obturator foramen. The obturator artery and vein (supplying muscles of the medial thigh) and the obturator nerve (motor to the adductors of the thigh and sensory to the medial thigh) pass through the obturator foramen. All of the vascular and nervous structures that traverse the obturator foramen travel laterally, allowing for safe passage of trocars along the medial aspect of the foramen [24].

### **The transobturator placement procedure**

The transobturator insertion procedure differs from TVT in that rather than passing through the retropubic space, the sling material is drawn through the vaginal incision and out the obturator foramina. Most transobturator sling procedures performed to date have been done by placing the

hooked needle through the obturator foramen through the medial thigh and drawing the sling out through a vaginal incision. In a modification of the transobturator technique developed by Delorme, De Leval [25] used specially designed instruments to perform an "inside-out" transobturator urethral sling using a TVT-type polypropylene sling. A specially designed helical passer was introduced through a vaginal incision and out through the obturator foramen. In theory, this inside-out approach lessens the possibility of inadvertent injury to the urethra, bladder, or vagina. In 250 women who have undergone inside-out transobturator sling, no such injuries have been reported [26]. As of yet, no prospective comparison of these two techniques has been performed.

Cadaveric anatomic studies have been conducted to determine the route of passage for slings placed using the transobturator approach. It was found that the tape travels in a horizontal plane across the origin of the adductor muscles and through the inferior margin of the obturator foramen. The tape then passes through the internal obturator muscle, above the pedicle of the internal pudendal artery, through the levator ani muscle, pass the tendinous arch of the pelvic fascia, and then beneath the middle third of the urethra. Importantly, no major vessels or viscera were encountered along the expected trajectory of the tape [27]. The significance of this tape placement was evaluated further with additional anatomic studies, which demonstrated that the sling penetrates through the vaginal attachments of the tendinous arch of the pelvic fascia. In this position, the tape parallel to the levator ani muscle restores the vaginal sling and serves as a urethral support rather than a urethral suspension [28]. Kocjancic *et al.* [29] demonstrated in cadaveric studies that properly placed transobturator tape lies 2 cm away from the urethra in the endopelvic space and 4 to 5 cm from the obturator nerve and vessels in the obturator foramen and endopelvic space. The angle formed between the tape and the urethra is approximately 15 degrees, which does not place extra anatomic strain on the urethra [29]. Although this route of tape placement theoretically eliminates the risk of injury to the viscera, vessels, and nerves, improper placement of the tunneling device increases the risk of vesical or vaginal perforation [30].

The inside-out approach pioneered by De Leval [25] also has been evaluated using cadaveric dissection studies. The trajectory was found to be significantly different from the trajectory demonstrated in cadaveric studies on the outside-in transobturator route. The shortest distance to the obturator nerve in five cadavers dissected was 22 mm and there was a sizable buffer zone between the tape and vascular structures of the pelvis and perineum [31].

### Proposed Mechanism of Action for Transobturator Urethral Slings

As with all midurethral slings, the purpose of a sling placed by the transobturator route is to create a firm backboard

for the urethra, which permits coaptation and urethral closure during periods of increased intravesical pressure. This action has been confirmed in 20 patients who underwent videourodynamic testing before and after transobturator urethral slings. It was demonstrated that urethral and cervical mobility was maintained in these patients after sling placement. The mid-urethra (where the tape was placed) was immobile during episodes of stress, but appeared free during voiding [32].

According to the hammock hypothesis, urethral hypermobility is a significant factor in the pathophysiology of SUI. To specifically evaluate the effect of transobturator urethral slings on urethral hypermobility, Minaglia *et al.* [33] reported results in 26 women with SUI who also had urethral hypermobility demonstrated by Q-tip test deflection of 30 degrees or greater. Mean preoperative straining Q-tip deflection was significantly higher than postoperative deflection (57.3 degrees vs 48.4 degrees, respectively). Objective cure per urodynamics was 84%. Twenty-one (80.8%) of these patients had Q-tip deflection angles of greater than 30 degrees after surgery, 19 of whom were subjectively and objectively cured of SUI. The remaining five patients had deflection of less than 30 degrees; two of these patients had subjective and objective cure of SUI and two had subjective cure of SUI. The remaining patient reported subjective improvement. It was concluded based on these data that correction of proximal urethral hypermobility is not the mechanism of efficacy in transobturator urethral slings [33].

In a similar study, Ghoniem and Khater [34] evaluated transobturator urethral slings in the treatment of 15 women with SUI and urethral hypermobility demonstrated by greater than 30 degrees of deviation per Q-tip test. Five other women with SUI and no urethral hypermobility also were included in the analysis. Fourteen patients underwent concomitant colporrhaphy and two had excision of a periurethral mass. Sixteen of the 20 patients became dry or had improvements in their symptoms. Of the four women who did not experience improvement, three had immobile urethras on the Q-tip test. The authors concluded that the transobturator approach is particularly efficacious in treating SUI related to urethral hypermobility [34].

### Efficacy and Safety Data on Transobturator Urethral Slings

The initial report of the transobturator approach for urethral sling was by Delorme [35••] in 2001. Sixteen patients with pure SUI and 24 patients with SUI and pelvic prolapse comprised the initial study group and were followed for 3 to 12 months. The only major complication was a single case of sepsis. Fifteen of the 16 (93.8%) patients with SUI only were cured and one (6.2%) was improved. All of the 24 patients with concomitant prolapse were cured of SUI [35••].

In a follow-up study, Delorme *et al.* [36] reported 1-year follow-up results for 32 women without vaginal prolapse who underwent transobturator sling placement for SUI. Twenty-nine (90.6%) were cured (defined as no leakage, no use of urinary pads, and negative cough test) and three (9.4%) were improved (defined subjectively by the patient). Five patients had urodynamic findings consistent with bladder outlet obstruction (decreased urinary flow rate or increased postvoid residual urine). One of these patients required self-catheterization for 4 weeks postoperatively. Two patients developed de novo urge incontinence.

A prospective, multicenter trial in France evaluated the short-term outcomes of transobturator urethral slings using Uratape (Mentor Corporation, Santa Barbara, CA) in 183 women with SUI. Twenty-six women (14.2%) had previously undergone anti-incontinence surgery. Twenty-six women (14.2%) underwent concomitant surgery for prolapse along with transobturator urethral sling placement. Mean follow-up was 7 months (range, 1–21 months). Complications included one bladder perforation, two urethral perforations, one vaginal perforation, five cases of sling erosion or extrusion requiring sling excision, and four cases of de novo urge incontinence. One-hundred seventy-six patients presented for follow-up at 3 months, with 159 (85.6%) reporting cure of SUI and an additional 14 (7.9%) reporting improvement. At 6 months, 130 patients presented for follow-up, with 108 (83%) reporting cure and seven (5.4%) reporting improvement. Fifty-six percent of patients reported resolution of urgency symptoms, with 21% reporting a decrease in urgency. Preoperative uroflowmetry data were available on 136 patients and 45 patients at 1 year postoperatively. Mean maximum flow rate decreased significantly ( $P < 0.05$ ) from 32 mL/sec preoperatively to 28 mL/sec postoperatively. There was no statistically significant change in voiding time and postvoid residual. Two patients had postvoid residual urine volume of more than 100 mL [37].

Cindolo *et al.* [38] reported 90-day results of 80 women (mean age, 56 years) with SUI and no significant pelvic organ prolapse (patients with grade-1 cystoceles were included) who underwent transobturator urethral sling placement using slings with a silicone-coated mid-portion (Uratape). The only intraoperative complication was a single bladder neck laceration repaired intraoperatively. Eight of the 80 patients (10%) required intramuscular ketorolac for analgesia postoperatively. One patient had postoperative vaginal erosion with inguinal abscess, necessitating sling removal. One patient developed urinary retention, which resolved spontaneously after 4 weeks. Two patients developed de novo urge incontinence. All of the patients with grade-1 (leak with cough;  $n = 20$ ) and grade-2 (leak with sports activity;  $n = 39$ ) SUI experienced resolution of SUI symptoms postoperatively. Five of eight patients (62.5%) with grade-3 SUI (leak with walking) were dry postoperatively and 11 of 13 (84%) of those with latent SUI were dry postoperatively. Average daily inconti-

nence pad use decreased significantly from 2.6 to 0.9. Statistically significant improvements were noted in patient self-assessment of quality of life (77.5% were very satisfied postoperatively vs 28.8% preoperatively) and sexual function (24 complained of dyspareunia or urine leakage during intercourse postoperatively vs 41 pre-operatively) [38].

Kocjancic *et al.* [39] evaluated 56 patients who underwent transobturator urethral sling placement. AUA incontinence symptom score was used to evaluate preoperative incontinence severity and postoperative change. Forty-nine (89%) patients were dry at the 1-year follow-up and four (7%) were improved. The average percent improvement in symptoms was 81%, with a decrease in average AUA symptom score from 16 to 3. There was no significant change in uroflowmetry after surgery. Two patients experienced extrusion of Uratape slings, two developed de novo urgency, and one required indwelling catheterization for 15 days [39].

Among the 107 women who underwent De Laval's [25] inside-out transobturator sling, 17 (15.9%) had undergone previous incontinence/prolapse surgery and 33 (30.8%) underwent simultaneous prolapse repair. There were no injuries to pelvic organs, nor was their significant blood loss. At the 1-month follow-up, one patient had minor vaginal erosion. Three patients developed complete urinary retention (two of whom had undergone prolapse repair) requiring urethrolisis. One patient developed a superficial venous thrombosis and subsequently a leg abscess that required incision. Unfortunately, data on relief of SUI symptoms were not presented; therefore, additional studies will be required to assess the role of this procedure in the management of SUI [25].

In the largest study to date on the transobturator urethral sling approach for SUI, Boccon-Gibod *et al.* [40] reported results of 441 patients who underwent transobturator urethral sling placement (233 with silicone mid-portion Uratape and 208 with non-silicone-coated Obtape [Mentor Corporation, Santa Barbara, CA]) at nine centers. The mean age was 58 years. Sixty-six patients (14.9%) underwent concomitant prolapse repair. Two-hundred ninety-two patients had at least 3 months of follow-up. Perioperative complications occurred in 13 (2.9%) patients, including two bladder perforations, four urethral perforations, and four vaginal perforations. Urinary retention occurred in nine patients (2%) and was treated by surgical urethrolisis in three, dilation in two, and short-term self-catheterization in four. Twelve patients (2.7%) had transient pain. Two-hundred forty-four of the 292 patients (83.6%), for whom at least 3 months of follow-up were available, had complete resolution of SUI. Twenty-seven (9.2%) patients were improved and 21 (7.2%) failed treatment. One hundred fifty-five patients had preoperative urgency or urge incontinence, which resolved, improved, stayed the same, or worsened in 77 (49.6%), 41 (26.5%), 30 (19.4%), and seven (4.5%) patients, respectively. Tape extrusion occurred in 13 patients using Uratape (5.6%) and in four patients using Obtape (1.9%). Three of the per-



forations involving Obtape were due to perforation of the sulcus of the vagina secondary to superficial tape placement [40]. Existing studies on transobturator urethral slings are summarized in Table 1.

### Transobturator Urethral Slings as a Secondary Procedure

Costa *et al.* [37] reported on the use of a transobturator sling for recurrent SUI after a previous failed procedure in 24 patients who had undergone various previous SUI treatment procedures. Nineteen (79%) reported cure, three (12.5%) reported improvement, and two (8.5%) reported treatment failure.

### Transobturator Urethral Slings in Patients Who Underwent Concomitant Prolapse Repair

Twenty-five of 26 patients who underwent simultaneous prolapse repair and transobturator urethral sling in the series by Costa *et al.* [37] were seen at follow-up; 23 (92%) were cured of prolapse and two (8%) experienced recurrent prolapse.

DeTayrac *et al.* [41] reported outcomes in 39 patients who underwent transobturator urethral slings and concomitant anterior or posterior pelvic organ prolapse repair. Twenty-four patients (61.5%) had pure SUI, whereas eight (20.5%) had SUI and urgency and seven (18%) had mixed incontinence. There was one vaginal perforation and one bladder perforation. Mean follow-up was 12 months. Thirty-four patients (87.2%) were dry at follow-up and three (7.7%) were improved. Urgency resolved in eight patients (53.3%) and improved in four (26.6%). Three patients with pure SUI preoperatively developed de novo urgency.

The transobturator approach alone has been described as a method for repair of anterior vaginal wall prolapse. Salomon *et al.* [42] reported outcomes in 27 women with grade-3 or grade-4 prolapse who underwent transobturator placement of porcine skin collagen with concomitant sacropinofixation. Nine patients (33%) also had urinary incontinence preoperatively. With a median follow-up of 14 months (range, 8 to 24 months), 22 (81%) patients had cure of pelvic prolapse. One patient (3.7%) had persistent grade-1 prolapse and four (14.8%) had persistent grade-2 prolapse. Seven of the nine patients with incontinence reported cure of incontinence postoperatively. One patient required sling removal at 1 year for chronic pain and another had recurrent prolapse at 18 months. Patients had statistically significant improvements in quality of life and urinary symptoms postoperatively [42].

### Transobturator Urethral Slings in Obese Patients

Droupy *et al.* [43] evaluated transobturator urethral slings in 48 obese patients with a body mass index greater than

30 compared with 197 non-obese patients who also underwent transobturator urethral sling placement. Fifty-one percent of the non-obese group had pure SUI compared with 31% of the obese group ( $P < 0.01$ ). Fifteen percent of the non-obese group had SUI and urgency without urge incontinence compared with 37% of the obese group ( $P < 0.001$ ). Cure of SUI occurred in 85.7% of the non-obese group and in 77.1% of the obese group, which is an insignificant difference. There were no other significant differences in outcome [43].

### Transobturator Urethral Slings in Elderly Patients

Vincent *et al.* [44] evaluated outcomes in 51 women older than 70 years of age from a cohort of 292 women undergoing transobturator urethral sling placement. At a mean follow-up of 11 months (2.6–23.7 months), continence rates were 80.4% and 84.2% for women older than or younger than 70 years of age, respectively. There was no statistically significant difference between the groups with regard to the rates of postoperative continence [44].

### Transobturator Urethral Sling in Men

There is a single case report in the literature of a transobturator approach for sling placement in a male patient. This 69-year-old patient suffered from severe SUI after radical prostatectomy for prostate cancer. After placement of a transobturator urethral sling, his urinary pad use decreased from six pads daily to one pad daily at the 7-month follow-up [45].

### Comparison of Transobturator Urethral Slings Versus Tension-Free Vaginal Tape

A prospective, randomized trial evaluated the difference between transobturator urethral slings and TVT. Sixty-one women with SUI were randomized to TVT with routine cystoscopy ( $n = 31$ ) or transobturator sling placement ( $n = 30$ ) performed by one or two surgeons. All of the patients received general or spinal anesthesia. All of the subjects completed a quality-of-life survey (including assessment of daily activities, effort activities, self-image, emotional impact, sexuality, and overall well-being) and underwent urodynamic evaluation preoperatively and 29 from the TVT group and 27 from the transobturator group underwent repeat quality-of-life surveys and urodynamics 1 year postoperatively. Preoperatively, there were no statistically significant differences between the two groups, although more patients in the transobturator group than in the TVT group had undergone previous SUI surgery (13.3% vs 3.2%, respectively) and more patients in the TVT group than in the transobturator group had undergone previous hysterectomy (16.1% vs 6.7%, respectively). Mean operative time was significantly less for the transobturator approach than for the TVT group (14.8 minutes vs 26.5 minutes,

Table 1. Existing studies on transobturator urethral slings

Study	Patients seen at follow-up, %	Mean follow-up	Cured of SUI, %	Improved SUI, %	Failed, %	Cured/ improved urgency, %	Improved urgency, %	New or worse urgency, %	Erosions, %	Perforations, %	Short-term urinary retention, %
Delorme [35••]	32	12 months	90.6	9.4							
Cindolo et al. [38]	80	3 months	93.8	N/A							
De Leval [25]	107	N/A	N/A	N/A	N/A	N/A	N/A	N/A	< 1	0	2.8
Costa et al. [37]	130	6 months	83	5.4	11.6	56	21	~3	3.8	~3	0
Boccon-Gibod et al. [40]	292	3 months	83.6	9.2	7.2	49.6	26.5	5.8	7.5	2.9	3.1
Kocjancic et al. [39]	56	12 months	89	7	4	N/A	N/A	3.6	3.6	0	1.8
DeTayrac et al. [41]	39	12 months	87.2	7.7	5.1	53.3	26.6	7.7	0	5.1	0

SUI—stress urinary incontinence.

respectively). There were three bladder perforations in the TVT group versus none in the transobturator group. Other minor complications included one urethral erosion in the TVT group, one case of urinary retention in the transobturator group, which required urethrolisis, one obturator hematoma in the transobturator group, and urinary infection in six transobturator and four TVT patients. None of these differences were statistically significant. Complete relief of SUI symptoms and negative cough test were observed in 27 (90%) of the transobturator patients and 26 (83.4%) of the TVT patients. Twenty-six (86.7%) of the transobturator and 30 (96.8%) of the TVT patients reported being satisfied or very satisfied with the procedure. There were no significant differences in postoperative quality of life or urodynamic outcomes [16••]. Had routine cystoscopy not been performed with TVT, operative times may have been comparable between the two procedures.

### Complications of Transobturator Sling Placement

Despite the theoretical increased safety of the transobturator approach, bladder perforation requiring short-term catheter drainage has been reported with transobturator urethral slings [46]. Urethral erosions were more common early in the transobturator approach experience and are thought to be related in large part to the silicone coating used in the midportion of some of the original transobturator slings [47]. Pure polypropylene slings are used more commonly today and have extrusion rates similar to other polypropylene slings [37]. Vaginal erosion continues to be a known complication of the procedure, with incidence as high as 13.8% in some series [48]. Vaginal erosion may present with persistent vaginal discharge, pain, or dyspareunia [48]. Perineal abscess requiring drainage has been reported in association with sling erosion [49]. Excision of the exposed mesh typically is required to resolve the symptoms. In the series by Domingo *et al.* [48], two of nine patients (22%) who had excision of exposed mesh developed recurrent SUI. Postoperative obstructive voiding symptoms also occur with a low frequency after transobturator suburethral sling placement [50]. Many patients who present with obstructive symptoms are treated successfully without compromising the procedure's efficacy by loosening the sling [50]. No fatalities have been reported from placement of transobturator urethral slings.

### Future Directions for the Transobturator Urethral Sling

Additional studies with long-term follow-up are needed to further validate the safety and efficacy of this procedure when compared with the gold standard TVT urethral sling. It also will be of interest to further evaluate the "inside-out" approach of De Laval [25] compared with the "outside-in" approach of Delorme [35••].

### Conclusions

The transobturator approach for urethral sling placement has shown great promise in the treatment of SUI. The efficacy of urethral slings placed by the transobturator route has been shown to be similar to that of TVT slings. The procedure is relatively simple to perform and is well tolerated by patients. Additional studies are indicated to further elucidate the role of this new procedure in the treatment of SUI.

### References and Recommended Reading

Papers of particular interest, published recently, have been highlighted as:

- Of importance
- Of major importance

1. Abrams P, Cardoza L, Fall M, *et al.*: The standardization of terminology of lower urinary tract function: report from the Standardization Subcommittee of the International Continence Society. *Neurourol Urodyn* 2002, 21:167–178.
  2. Nygaard IE, Heit M: Stress urinary incontinence. *Obstet Gynecol* 2004, 104:607–620.
  3. DeLancey JO: Structural support of the urethra as it relates to stress urinary incontinence: the hammock hypothesis. *Am J Obstet Gynecol* 1994, 170:1713–1720.
- Discusses the mechanisms of continence and provides the theoretical basis for midurethral slings as a treatment for SUI.
4. Walters MD, Daneshgari F: Surgical management of stress urinary incontinence. *Clin Obstet Gynecol* 2004, 47:93–103.
  5. Borello-France D, Burgio KL: Nonsurgical treatment of urinary incontinence. *Clin Obstet Gynecol* 2004, 47:70–82.
  6. Von Giodano D: Twentieth Congress. *Franc de Chir* 1907, 506.
  7. Aldridge AH: Transplantation of fascia for the relief of urinary incontinence. *Am J Obstet Gynecol* 1942, 44:398–411.
  8. Bukkapatnam R, Rodriguez LV: Synthetic sling options for stress urinary incontinence. *Curr Urol Rep* 2004, 5:374–380.
  9. Ulmsten U, Henriksson L, Johnson P, Varhos G: An ambulatory surgical procedure under local anesthesia for treatment of female urinary incontinence. *Int Urogynecol J Pelvic Floor Dysfunct* 1996, 7:81–85.
  10. Ulmsten U, Johnson P, Rezapour M: A 3-year follow-up of tension-free vaginal tape for surgical treatment of female stress urinary incontinence. *Br J Obstet Gynaecol* 1999, 106:345–350.
  11. Rackley RR, Abdelmalak JB, Tchetgen MB, *et al.*: Tension-free vaginal tape and percutaneous vaginal tape sling procedures. *Tech Urol* 2001, 7:90–100.
  12. Deval B, Levardon M, Samain E, *et al.*: A French multicenter clinical trial of SPARC for stress urinary incontinence. *Eur Urol* 2003, 44:254–259.
  13. Daher N, Boulanger JC, Ulmsten U: Pre-pubic TVT: an alternative to classic TVT in selected patients with urinary stress incontinence. *Eur J Obstet Gynecol Reprod Biol* 2003, 107:205–207.
  14. Nilsson CG, Kuuva N, Falconer C, *et al.*: Long-term results of the tension-free vaginal tape (TVT) procedure for the surgical treatment of female stress urinary incontinence. *Int Urogynecol J Pelvic Floor Dysfunct* 2001, 12(suppl 2):S5–S8.
  15. Ward K, Hilton P: Prospective, multicenter, randomized trial of tension-free vaginal tape and colposuspension as primary treatment for stress incontinence. *BMJ* 2004, 190:324–331.
  16. deTayrac R, Deffieux X, Droupy S, *et al.*: A prospective, randomized trial comparing tension-free vaginal tape and trans-obturator suburethral tape for surgical treatment of stress urinary incontinence. *Am J Obstet Gynecol* 2004, 190:602–608.
- Head-to-head comparison of the transobturator approach with the gold-standard TVT procedure.
17. Hodroff M, Portis A, Siegel SW: Endoscopic removal of intra-vesical polypropylene sling with the holmium laser. *J Urol* 2004, 172:1361–1362.

18. Bafghi A, Benizri EL, Trastour C, *et al.*: Multifilament polypropylene mesh for urinary incontinence: 10 cases of infections requiring removal of the sling. *BJOG* 2005, 112:376–378.
  19. Tamussino KE, Hanzal E, Kolle D, *et al.*: Tension-free vaginal tape operation: results of the Austrian registry. *Obstet Gynecol* 2001, 98:732–736.
  20. Castillo OA, Bodden E, Olivares RA, Urena RD: Intestinal perforation: an infrequent complication during insertion of tension-free vaginal tape. *J Urol* 2004, 172:1364.
  21. Johnson DW, ElHajj M, OBrien-Best EL, *et al.*: Necrotizing fasciitis after tension-free vaginal tape (TVT) placement. *Int Urogynecol J Pelvic Floor Dysfunct* 2003, 14:291–293.
  22. Klutke C, Siegel S, Carlin B, *et al.*: Urinary retention after tension-free vaginal tape procedure: incidence and treatment. *Urology* 2001, 58:697–701.
  23. Nickel RF, Wiegand U, Van den Brom WE: Evaluation of a transpelvic sling procedure with and without colposuspension for treatment of female dogs with refractory urethral sphincter mechanism incompetence. *Vet Surg* 1998, 27:94–104.
  24. Moore K: *Clinically Oriented Anatomy*, edn 3. Philadelphia: William and Wilkins; 1992.
  25. De Leval J: Novel surgical technique for the treatment of female stress urinary incontinence: transobturator vaginal tape inside-out. *Eur Urol* 2003, 44:724–730.
  26. Delmas V, De Leval RE: Novel surgical technique for the treatment of female stress urinary incontinence: transobturator vaginal tape inside-out. *Eur Urol* 2004, 46:134.
  27. Delmas V, Ortuno F, *et al.*: Anatomical structures by a transobturator sling crossed (Uratape) to treat urinary incontinence female. Presented at the 25th Congress of the International French Society of Urodynamics. Bruxelles, France: May 2002.
  28. Delmas V, Ortuno G, *et al.*: The Uratape transobturator sling in the treatment of female stress urinary incontinence: Mechanism of Action. Presented at the 25th Congress of the International French Society of Urodynamics. Bruxelles, France: May 2002.
  29. Kocjancic E, Costa P, Wagner L, *et al.*: Safety and efficacy of the transobturator tape in the treatment of stress urinary incontinence [Abstract 116]. Presented at the International Continence Society Annual Meeting. Paris: August 25–27, 2004.
  30. Delmas V, Hermieu J, Dompeyre P, *et al.*: The transobturator tape (TOT): anatomic dangers. Presented at the 18th Congress of the European Association of Urology. Madrid: March 20–23, 2003.
  31. Bonnet P, Waltregny D, Reul O, De Leval J: Transobturator vaginal tape inside out for the surgical treatment of female stress urinary incontinence: anatomical considerations. *J Urol* 2005, 173:1223–1228.
  32. Fillipi B, Benisty M, *et al.*: Uratape, a new stress and normal voiding? Value of cystography, preliminary results. Presented at the 25th Congress of the International French Society of Urodynamics. Bruxelles, France: May 2002.
  33. Minaglia S, Ozel B, Hurtado E, *et al.*: Effect of transobturator tape procedure on proximal urethral mobility. *Urology* 2005, 65:55–59.
  34. Ghoniem G, Khater U: Is transobturator tape (TOT) effective in the treatment of stress urinary incontinence with intrinsic sphincter deficiency?. Abstract presented at the International Continence Society Annual Meeting. Paris: August 25–27, 2004.
  35. Delorme E: Transobturator urethral suspension: mini-invasive procedure in the treatment of stress urinary incontinence in women. *Prog Urol* 2001, 11:1306–1313.
- The original description of the transobturator approach for the treatment of SUI.
36. Delorme E, Droupy S, De Tayrac R, Delmas V: Transobturator tape (Uratape): a new minimally invasive procedure to treat female urinary incontinence. *Eur Urol* 2004, 45:203–207.
  37. Costa P, Grise P, Droupy S, *et al.*: Surgical treatment of female stress urinary incontinence with a trans-obturator-tape (T.O.T.®) Uratape®: short-term results of a prospective multicenter study. *Eur Urol* 2004, 46:102–106.
  38. Cindolo L, Salzano L, Rota G, *et al.*: Tension-free transobturator approach for female stress urinary incontinence. *Minerva Urol Nefrol* 2003, 55:89–98.
  39. Kocjancic E, Gherzi R, Carone R, *et al.*: Outcomes and complications of transobturator tape (TOT): 1-year follow-up [Abstract 304]. Abstract presented at the International Continence Society Annual Meeting. Paris: August 25–27, 2004.
  40. Boccon-Gibod L, Grise P, de Tayrac R, *et al.*: Transobturator tape (T.O.T.®) for the treatment of female stress urinary incontinence: a multicentric, prospective study [Abstract 311]. Abstract presented at the International Continence Society Annual Meeting. Paris: August 25–27, 2004.
  41. De Tayrac, Costa P, Grise P, *et al.*: Transobturator tape procedure for females with stress urinary incontinence and concomitant pelvic reconstruction surgery for genital prolapse: one year follow-up. Abstract presented at the International Continence Society Annual Meeting. Paris: August 25–27, 2004.
  42. Salomon LJ, Detchev R, Barranger E, *et al.*: Treatment of anterior vaginal wall prolapse with porcine skin collagen implant by the transobturator route: preliminary results. *Eur Urol* 2004, 45:219–225.
  43. Droupy S, De Tayrac R, Grise P, *et al.*: Outcome of obese female patients treated by T.O.T.® for stress urinary incontinence [Abstract 692]. Presented at the International Continence Society Annual Meeting. Paris: August 25–27, 2004.
  44. Vincent D, Philippe G, F M, *et al.*: T.O.T.®: Clinical outcome in elderly female patients with stress urinary incontinence. Abstract presented at the International Continence Society Annual Meeting. Paris: August 25–27, 2004.
  45. Palma PC, Dambros M, Thiel M, *et al.*: Readjustable transobturator sling: a novel sling procedure for male urinary incontinence. *Urol Int* 2004, 73:354–356.
  46. Minaglia S, Ozel B, Klutke C, *et al.*: Bladder injury during transobturator sling. *Urology* 2004, 64:376–377.
  47. Gunnemann A, Heleis W, Pohl J, *et al.*: The transobturator tape (TOT): a minimally invasive procedure for the treatment of female urinary stress incontinence. *Urologe A* 2004, 43:1106–1110.
  48. Domingo S, Alama P, Ruiz N, *et al.*: Diagnosis, management, and prognosis of vaginal erosion after transobturator suburethral tape procedure using a nonwoven thermally bonded polypropylene mesh. *J Urol* 2005, 173:1627–1630.
  49. Game X, Mouzin M, Vaessen C, *et al.*: Obturator infected hematoma and urethral erosion following transobturator tape implantation. *J Urol* 2004, 171:1629.
  50. Ozel B, Minaglia S, Hurtado E, *et al.*: Treatment of voiding dysfunction after transobturator tape procedure. *Urology* 2004, 64:1030.